

Negative Index Aberrations

D. Schurig and D.R. Smith,
Duke University, ECE Department, Box 90291, Durham, NC, 27708.

Negative refraction has been demonstrated computationally and experimentally in photonic crystals^{1,2}. There has even been some success in obtaining super resolution from negative refracting PC slabs, i.e. "perfect lenses"². While a "perfect lens" would offer unique capabilities for near field focusing, the vast majority of optical devices must operate on far field radiation, which is unaffected by homogenous slabs. We have examined the application of negative index media to traditional, curved, far field lenses. We find that these negative index lenses offer clear performance advantages over their positive index lenses counterparts.

We examine the Seidel aberrations of thin spherical lenses composed of media with refractive index not restricted to be positive. We find that consideration of this expanded parameter space allows for the reduction or elimination of more aberrations than is possible with only positive index media. In particular, we find that spherical lenses possessing real aplanatic focal points are possible only with a negative index. We perform ray tracing that confirms the results of the aberration calculations³.

[1] S. Foteinopoulou, E. N. Economou, and C. M. Soukoulis, *Phys. Rev. Lett.* **90**, 107402 (2003).

[2] E. Cubukcu, K. Aydin, E. Ozbay, S. Foteinopolou, C. M. Soukoulis, *Phys. Rev. Lett.* **91**, 207401 (2003).

[3] D. Schurig, D.R.Smith, *Phys. Rev. E*, **70**, 065601 (2004).